

CHAPTER 7

THE FUTURE OF IETMS

7.1 Introduction

Technology does not stand still; neither will the development or application of IETMs. New, more cost-effective methods for legacy conversion will be developed. Faster computers and better monitors will permit a wider range of multimedia use. Users will demand real-time access to data. As more information systems are fielded by the military, the user will eventually have access to a completely integrated operation that includes training, parts ordering/requisitioning, and expert systems.

Responding to an increasingly likely scenario that future military operations will consist of joint missions and in which one Service might be required to repair another Service's equipment, DoD formed the Tri-Service IETM Interoperability Committee. The Joint Commanders Group for Communication and Electronics (JCG-CE) tasked the committee to develop guidance and policy to accomplish the following:

- Develop a uniform approach for electronically communicating and accessing technical data throughout DoD
- Maximize the use of C/NDI technology in the process
- Develop a common user information interface for field delivery systems

The committee is composed of representatives responsible for IETM policy from each of the services, and contractors with extensive experience with IETM development. It is important to point out that the committee is concerned with user interoperability, not data interoperability. (Another IETM committee is addressing data interoperability, basically the implementation of MIL-PRF-87269.) The committee meets on a bi-monthly basis and is conducting a DoD study to develop a solution for the JCG-CE and other IETM development and delivery issues.

7.2 Objective of the Study

The objective of the DoD study has been to create a high-level Joint IETM Architecture (JIA) to guide and standardize IETM acquisition, management, and display. This architecture will:

- a. Enable maximum interoperability in the use of technical information to meet the needs of the Defense Logistics community in supporting the material readiness of the military.
- b. Serve as the basis for a formal DoD-wide adoption of the proposed approach in promulgating the required acquisition and field-support policy. To reduce the risk of implementation and to demonstrate utility of the approach, the policy recommendations are based on a series of FY99 pilot demonstration programs that will show the applicability of the Architecture to support IETMs for the whole spectrum of military systems.

7.3 Goal for the Architecture

The primary goal for the JIA is to establish a technical framework for acquisition and deployment of the whole spectrum of ETMs. When completed, the user will be able to view and utilize technical information distributed to the work location through a common user-interface, no matter what the authoring source or data format. In so doing, the DoD will be able to establish a unified approach to the acquisition, management, and use of existing and newly procured IETMs.

To meet this goal, the overall approach will be based on maximum use of existing Commercial/Non Developmental Items (C/NDIs), the Internet and World Wide Web technology. Another goal is to achieve end-user-level interoperability of the IETMs delivered to and used by the entire DoD Operational Community. In this context, an ETM or IETM is defined as having end-user interoperability when it can enable a user with one common, commercially available display device, (such as a portable personal computer) to:

- View and interact with technical information from any source and of any internal format.
- Automatically access and view, by means of an electronic-link reference in the displayed technical information, additional information in any other ETM or IETM.

7.4 Technical Approach

The overall concept of this JIA effort is to utilize the group of emerging technologies that the commercial marketplace is rapidly adopting as the standard for distributable electronic documents, which are, in general, based on the technology of the Internet and the World Wide Web. For security and operational reasons, the DoD will not utilize the public Internet or the World Wide Web, but will employ essentially the same technology and C/NDI products in a private and dedicated DoD intranet environment. Such an approach is becoming the *de facto* standard for corporate information distribution systems worldwide. Once this approach has been proven effective, a set of implementation-guidance documents and performance specifications will be developed within this comprehensive, DoD-wide, commercially supported framework.

A major objective of the JIA effort is to demonstrate user interoperability of proprietary and legacy IETMs. This will be accomplished by encapsulating them into a common-view package format, which can be electronically distributed to DoD intranets and eventually viewed by a user employing a single interface (i.e., browser). This process is referred to as "object encapsulation." Such a demonstration will require the establishment of the following technical capabilities:

- An authoring framework to effectively create and manage IETM view packages for delivery to the Government, regardless of which authoring tools are used.
- An infrastructure that permits a military agency to distribute, manage, and deliver these IETM view packages.

- A methodology for the user to access and view the required technical information and to retrieve relevant data from other IETMs, including those of other Services, as necessary.

In order to achieve interoperability, the interface requirements recommended for the JIA will be specific, but they will be constructed so as to encourage innovative and effective solutions, especially in light of the constantly expanding technology base. Achieving this balance has required some decisions that may need to be re-examined over time. Whenever possible, the design will adhere to open standards and/or *de facto* Internet standards widely implemented by multiple vendors, with clear intent to maximize the use of commercially available software products.

7.5 Overview of the Architecture

The JIA is firmly based on proven and widely accepted Internet and World Wide Web technology, implemented as a private Web on a contained intranet. This intranet can be configured as a private DoD World-wide network (e.g., the Global Combat Support System – GCSS), as a combat-capable, unit-wide local intranet, or simply as a group of computers in close proximity hard-wired in a local Ethernet configuration. It can also be configured in a single display device (portable or workstation personal computer) which operates as both a client browser and a personal single-user Web server. The technology for implementing such an intranet is low-risk, easily implemented, and widely understood.

The proposed Architecture is based entirely on C/NDI technology. The Architecture has a dedicated Web intranet with at least one Web-browser client and at least one Web server -- more precisely, an HTTP (Hypertext Transfer Protocol) server and its included file-based store -- as well as a network to connect them if they are not contained in the same computer.

The specific implementation of the network, which is typically a TCP/IP (Transmission Control Protocol/Internet Protocol)-based network when more than one device is involved, will typically vary from one implementation to another. As will be described more fully below, the intranet may include other optional database servers and application servers in addition to the principal HTTP Web server.

7.6 JTA Compliance

The Joint IETM Architecture will be compliant with the DoD Joint Technical Architecture (JTA). Individual services or programs may define the operating environments for their IETM applications, but neither the JIA nor the JTA require a specific operating system. In technical terms, the “glue” (i.e., the communication protocol) that holds intranet Webs together is the Web protocol HTTP operating over the communications protocol TCP/IP, not the requirement for common operating systems. A TCP/IP network (e.g., an intranet) can easily accommodate multiple operating systems on its server and client computers.

7.7 JIA Use of Internet and World Wide Web Technology

The approach to developing a solution for this interoperability problem has been to adapt commercial and industry applications involving electronic documentation for which there is

widespread vendor product support. A JIA-compliant IETM product will apply the vendor software and standards being developed for the World Wide Web and the Internet in a dedicated and private intranet environment. Following the rapid change trend in Internet technology, the JIA has been designed to be extensible, flexible, and able to accommodate the predictable rapid growth in technology for all aspects of the Internet, the Web, and emerging electronic documentation applications.

The Web is, by its nature, a client/server architecture. On the client/server spectrum, JIA-compliant IETM applications may differ in emphasis from a major “server-centric” trend that is emerging for many commercial enterprise applications. The recommendations for implementation of the JIA are intentionally biased towards a model employing encapsulated objects downloaded to a portable device for use. In this approach, the server is preferred as a utility electronic bookshelf for IETM view packages (i.e., the package of encapsulated IETM objects). By analogy, these digital books are designed so they can easily be moved to another electronic bookshelf at another physical library site, reflecting the operational reality of the military unit itself. On the other hand, commercial Web sites tend to be permanently located corporate resource centers where servers and the information providers are co-located. For these commercial activities, the mobile and less controlled entity is the user client. In these applications, the preference is towards server-centric computing and the use of server-oriented, Web-object components. The corporate personnel resources for maintaining both the Web server and the content are located at the Web site. In military applications, the server sites resemble a technical library rather than a computer information center. Technical expertise lies with the content creator or the user and not the administrator of the server. This situation at this time dictates total object-encapsulation and “client-centric” computing as the primary emphasis of the JIA.

Progress in Web-oriented technology and the availability of secure, affordable military intranets offering global connectivity may change this in the future. Thus, the JIA is intentionally designed not to preclude other solutions, should such a change occur. It is important to emphasize that any implementing policy for the JIA must include some specific guidance on how to apply the Architecture, as well as the requirement to conform to the Architecture. The use of custom servers is an important issue for which guidance must mature. Guidance documents for the acquisition of JIA-compliant IETMs must be continually updated. Updates must be based on a continuing study of emerging military requirements, as compared with the current state of commercial technology and available C/NDI commercial products.

7.8 Proposed Requirement Documents for Implementation of the Architecture

This section summarizes initial recommendations for the baseline requirement documents for the JIA, development of JIA-compatible IETMs, and infrastructure capability.

In addition to requiring the HTTP and TCP/IP networking protocols used by the Internet and commercial Web-based intranet products, the JIA will be specified in the following areas:

- **Object Encapsulation and Component Interface.** This specification is needed for definition of the delivery, transport, and structure of the integrated collection of software components and data contained in the IETM view packages. This specification includes the interface

between multiple components when they exist, and the automated mechanisms for placing the IETM on the targeted intranet. It will also include requirements for the capability to automatically install these components on a user device in a manner sufficiently simple so that no professional system administrator is needed. It will include a primary specification to tell the IETM developers in what form they are to deliver the IETM view package.

- **Intranet Server and Database Interface.** For those IETMs that require the services of an application server and/or a database server, the IETM supplier must provide the proper software extensions to the basic JIA intranet Web server if they are not already in place. This specification outlines cooperation between the developers of the user intranet infrastructure and the IETM provider, and the interfaces and protocols involved. The JIA is designed to recognize that it will be necessary to install software using conventional system administration practices on fielded servers in order to achieve needed functionality. (This is not the case for the components fielded on JIA-conforming user browsers.) This specification/guidance document will provide the requirements that an IETM provider must consider when proposing or delivering such a capability for a JIA intranet.
- **Common Browser.** The immediate target for this specification will be the procurers of user PEDDs (Portable Electronic Delivery Devices) and workstations, since the installation of this standard browser will be required for these devices. The browser software component must be pre-installed on the PEDD since it is not included in the IETM view package. IETM source will also be affected by this specification since the IETM must be formed and viewed using any JIA-compliant browser. Two products dominate the Web-browser commercial marketplace at present, Microsoft Internet Explorer and Netscape Navigator, and the thrust of this specification is to specify the configuration of each so that they will be functionally equivalent in any JIA intranet. This will involve some extensions to the commercially-released products via plug-ins and controls. There would be viewing capabilities common in military IETMs such as CGMs or the common PDF used for legacy TMs.
- **Electronic Addressing and Library Model.** This overarching specification holds the enterprise collection of IETM information together by means of digitally encoded and executable-link references. The specification itself will define the syntax and mechanism for building and executing the automated links to the IETM content and the IETM presentation software. Two additional areas, regarding administration and enforcement of the recommendations, are needed so that the enterprise-wide addressing concept will work. The Electronic Addressing and Library Model specification will discuss these aspects, which includes the actual bureaucratic administration and allocation of the DoD-wide IETM “address space.” This is the indexing or Uniform Resource Locator (URL)-based electronically processed numbering system to which the services and their suppliers must subscribe. The specification will also discuss the area of the library model that can be used to perform an intelligent content-based access to another IETM when the exact specific locator is not known. To support the proposed Library Search functionality, the specification will also specify and require metadata files, encoded in eXtensible Markup Language (XML), which will serve as the primary search index files.

The Object Encapsulation and Component Interface, Intranet Server and Database Interface, Common Browser, and Electronic Addressing and Library Model technical descriptions are all

needed to affect interoperability of disparate IETMs in the field. The specific DoD form of these technical descriptions (i.e., whether they all should be formal DoD Performance Functional Specifications or some other type of guidance document) will be determined at the time the final recommendations are formulated at the end of the DoD Interoperability Project.

The overall interoperability goal is the ability to view any IETM with any browser that conforms to the JIA Common Browser technical description. It also requires that all cross-references by one IETM to another IETM be encoded in a standard manner (i.e., in conformance with the Electronic Addressing technical descriptions) so that the IETM browser can access the referenced IETM by a simple user selection (e.g., a mouse click). The other two specification areas are subordinate to these two user requirements. But they are needed to ensure that contractor-delivered IETM view packages and the DoD infrastructure provide the necessary user interoperability.

The following paragraphs contain a short summary of the concept and philosophy embodied in each technical description.

7.8.1 Object Encapsulation and Component Interface Technical Description

A core philosophy underlying this architecture is that developers of IETMs can deliver, as a single view package, all capability in the form of data and software contents needed to install and use an IETM on a standard DoD intranet. This technical description provides the IETM suppliers with the form needed to package and deliver the digitally encoded IETM. This view package may contain both content data and software components. These are combined into encapsulated objects and delivered as a contract package for electronic archiving or subsequent store-and-forward management. No provision is made for separately delivering an IETM player or piece of viewer software for installation onto the user device. The view package contains the capability to be automatically installed onto the user intranet upon arrival.

The encapsulated data and software objects will eventually be delivered by the operational infrastructure to the field user as though they were simple binary data packages. These packages will be treated by the infrastructure as file-oriented data destined for an agency intranet Web server. The packages will appear simply as generic “buckets of sequenced bits” that make sense to the server. The infrastructure activity need only make certain that these bits remain packaged together. The view package is a set of industry standard binary files, each of which is assigned a JIA notional locator (e.g., a URL [Universal Resource Locator] conforming to the JIA addressing model) that contains sufficient information to support its installation as data in the intranet server file system.

The complexity and degree of integration of these view packages will vary greatly among differing IETMs. Some will simply be two-part collections of one software component and one data set. The simplest form will be a single set with all of the needed software contained in the standard JIA browser. In other forms, a system of software components and possible multiple data sets will spread out among several servers and the browser device when the IETM is operational. This would be the case when background software agents are operating that might be diagnosing and monitoring systems. Another emerging technology requiring complex IETM objects requires software agents (acting as mentors) to insert training aids into the job-aiding

presentation when the agent (a computer program) determines they are needed. In between is a spectrum of complexity, each level requiring a different object-encapsulation approach. The “object” nature of these view packages is that all the intelligence to construct the operational IETM on the target intranet is contained within the view package objects themselves. There is no standard for the internal constructs of the view package in the JIA. This is the characteristic of the object-oriented approach utilized by the JIA.

Until the point of receipt by the intranet server, the view package is processed as a single object. There are a variety of mature approaches for bundling a set of files with headers into a single data set (e.g., Internet MIME [Multiservice Internal Mail Extensions] Standards). The Architecture may use any of them, requiring only that the view package can be installed as a set of files on the intranet server(s). With this approach, no overt man-in-the-loop software-installation processes are required other than the automatic capability built into Web-capable browsers and servers. Many technical options exist for encapsulating view packages; however, this requirement for automated software-component installation using Industry-Standard Web practices is critical to determining the extent to which an encapsulation approach is satisfactory.

7.8.2 Server and Data-Base Interface Technical Description

The simplest way for the JIA to achieve IETM interoperability for the DoD is to utilize only generic Web servers. This approach will not require additional software to be installed on either the servers or the browser device. However, some legacy systems and some highly innovative new IETM applications may require custom server extensions and database interface components. For complex IETMs, which require extended services operating on an intranet server, installation will likely involve two phases. One phase will be to “extend” the intranet, a process governed by the Server and Database Interface Technical Description, and the other will be to install the data and required browser components, a process governed by the Object Encapsulation Technical Description.

Final recommendations on the use and encapsulation of server extensions will require additional technical investigations, since the technology and marketplace need to mature before the development of specific recommendations can be accomplished.

7.8.3 Browser Technical Description

In line with the philosophy of this Architecture to use de facto Industry Standards, the browser requirements are established by the two particular commercial products, which together have captured essentially the entire Web browser market. While it is possible to develop, assess, and evaluate a long list of needed and desirable requirements for the IETM browser, such an exercise would serve little purpose in light of economic and marketplace realities. New Web browsers are software products that are very complex and expensive to develop. Furthermore, the current products are being offered in the marketplace free of charge, effectively precluding the development of additional commercial general-purpose browser products. At this writing, these two products are Microsoft Internet Explorer and Netscape Navigator. Except for a few (but very important) capabilities discussed below, these two products are functionally identical. For existing Web pages, they perform in a similar fashion.

The Browser Technical Description will specify the appropriate version of the commercial browser products and a set of standard extensions (i.e., controls and/or plug-ins) to these browsers. These extensions will include common DoD data viewers for file formats such as PDF, SGML/XML, CGM Version 4 Graphics, and CALS raster images. Since an XML capability will be in the basic functional set, the Version 5 release of these two products will probably serve as the baseline. These will be the first versions of both browsers to support XML and both companies (Microsoft and Netscape) have aggressive plans to add this capability. The inherent capabilities of the JIA-compliant browser will include basic presentation methods, either native to the commercial browser or added to meet JIA requirement, so that the component portion of the encapsulated object can be assumed to be preinstalled on the user device. In most cases, these particular components need not be included in the view package. Native browser support includes components such as HTML layout, GIF (Graphics Interchange Format) viewers, and JPEG (Joint Photographic Experts Group) displays.

One major area of difference between the two browsers lies in the area of object brokering and the automatic downloading of components. Ideally, it would be desirable to require that IETMs operate with either browser in its out-of-the-box form; however, the JIA Study Team has concluded that such a policy would restrict some very needed capabilities regarding the “downloadable” components needed for the JIA object-encapsulation concept. The differences are due to the lack of cooperation on the part of the two competing companies (Netscape and Microsoft) to provide compatible solutions for the marketplace. The generic capability to automatically download and install software components is essential to the JIA, so it may be necessary to choose one over the other for a specific implementation. To support users of Microsoft Windows 95, 98, or NT-based devices (which includes the vast majority of portable devices available), it is desirable to utilize products supporting the Microsoft Distributed Component Object Model (DCOM) object standards that provide turnkey support of this feature. For communities employing Microsoft software, it is strongly recommended that both browser products be enhanced (by third party plug-ins if necessary) to support DCOM objects (especially the downloadable ActiveX controls). These are the most efficient formats for executable programs running in a Microsoft 32-bit operating system.

There is also a marked degree of difference in the way the two products handle Dynamic HTML (DHTML), an emerging technology for putting intelligence into actual Web pages. However, because of the lack of consensus in the vendor community on DHTML standards and the fact that there are options for this functionality, the JIA Study Team has not yet establish this requirement as part of the minimal baseline and currently discourages its use in DoD programs. The eventual goal is that all valid DoD IETMs be compatible with both the Internet Explorer and Netscape products. This may require some installed extensions to make the two products interchangeable to the maximum extent possible.

7.8.4 Electronic Addressing and Library Model Technical Description

The syntax for JIA electronic addressing will be based on the URL standard for the World Wide Web because it is widely implemented in virtually all Web-enabled vendor products. Any occurrence of a legitimate URL string of characters is automatically made “hot” in the vendor application, and a “mouse click” or two, on the hot spot, will launch a Web browser search which will locate the file referenced by the URL and display it on the screen. In addition to

requiring a standard syntax, the Electronic Addressing and Library Model Technical Description will also require that all of the Services maintain and publish a permanent registry of all valid references to the IETMs issued by that Service. Once published, a valid URL must not be changed. This type of URL is called a persistent URL. In order to ensure that URLs are indeed persistent URLs, the JIA recommends the use of virtual URLs (vURLs). These are URLs that use an administratively assigned server reference, notated by URL syntax; however, the referenced server exists in name only. That is, it does not actually exist on a network and is used for data management purposes only. When the IETM is installed on a network, the vURL is remapped to the server where the IETM data resides. (This is easily accomplished in practice using what are called Host files and/or Domain Name Services (DNS) in accordance with standard World Wide Web practice.)

The specification will address the requirement for the remapping of these vURLs (which reference a hypothetical server on the World Wide Web) into the actual server and file system locations on the intranet. The Specification will also outline an on-line, search-oriented Library Model and identify the requirement for a standard metadata package to support on-line searches. This metadata package will be encoded in XML and attached to each IETM view package, which will contain indexing information useful for automated search engines in identifying an IETM reference.

7.9 Basic JIA Operational Flow Diagram

Figure 7-1 shows the flow of IETMs through the JIA. It illustrates the employment of the JIA by the original IETM developer, the management infrastructure repository, the user-site intranet server, and the user who selects the next object to view via a point-and-click Web-browser interface. The presentation components referred to can be either client or server components or implied (i.e., omitted) in the cases in which they are preinstalled in the standard browser.

7.10 Benefits of Employing the Architecture

Although implementation of the JIA produces a number of significant benefits, it will primarily benefit the end user, the IETM developer and the DoD IETM Distribution Infrastructure.

7.10.1 Benefits from the User Perspective

The principal benefit of the JIA is that the user will be able to utilize a single device to read any DoD IETM, no matter which Service originated it. To accomplish this, the user accesses and views the IETMs with either a workstation personal computer in a shop environment or a PEDD. The portable device will be configured either as a network client attached to the unit intranet or it will be reconfigured to operate in stand-alone or detached mode. In either case, the display of the information on the user interface is identical, and the user cannot determine from the look-and-feel of a screen display the mode in which the device is operating.

A major benefit of the JIA to the user is that all information is viewed through a common and very familiar Web-browser interface. To access an IETM, the user selects a URL reference using one of the many access-screens or menu-select options available. This could be a favorite list, explicit entry, a preassembled list of active IETMs on a unit Home Page, a hot-spotted index

graphic, or a Web page job assignment form listing the needed technical references. All of these are common practices borrowed directly from the World Wide Web community. From the user's perspective, the referenced IETM content simply appears in the browser window.

A major benefit to the user organization is that no explicit software installations are required to utilize an IETM even on a new out-of-the-box JIA-conforming browser device. Depending on the browser security level set, the user may, need to accept software components that require installation by an acknowledgment but for which no explicit installation action is needed; the browser installs the components automatically. This is an essential user-friendly feature of the JIA. Thus, there is no need for a trained and certified system administrator to install user software.

Another key benefit of the JIA is that the Web-based access methodology is a proven "point and click" user interface. If one IETM contains a reference to another IETM, the user can "click" on the highlighted reference and that referenced IETM will appear in the browser window (assuming, of course, the referenced IETM exists on the user's intranet). This second IETM can in turn reference a third IETM. To return to the original IETM, the user simply uses the "back" arrow on the browser interface, effectively reversing the references. Modern Web browsers can handle many levels of such nested referencing with no performance degradation. From the user perspective, the JIA is thus intended to make the use of disparate IETMs as easy and "seamless" as possible with modern technology. Because of the nature of the Web browser technology employed, the user experiences a great deal of common "look-and-feel" in the interactive (navigation-control) area, even if the individual IETM user-interface for the content varies.

A common practice on the World Wide Web is the use of search engines such as those employed by Yahoo and Excite. The JIA Library Model and the required standard XML-encoded metadata package are specifically designed to facilitate the inclusion of search engines on a JIA-conforming intranet. In these search engines, the user will enter a list of key words or reference designators and the search engine will identify possible IETM references available on the user's intranet. The JIA will not specify the search engine, but a rich selection of commercially available search engines, which build their indices from XML- and HTML-encoded sources and can easily be employed on a JIA intranet, is expected. The ability to get all the information needed to perform a task in a timely and convenient manner has, from the beginning of the IETM concept, been one of the promised performance-enhancing capabilities of IETMs. This JIA implementation, using low cost commercially available technology, will permit realization of this capability.

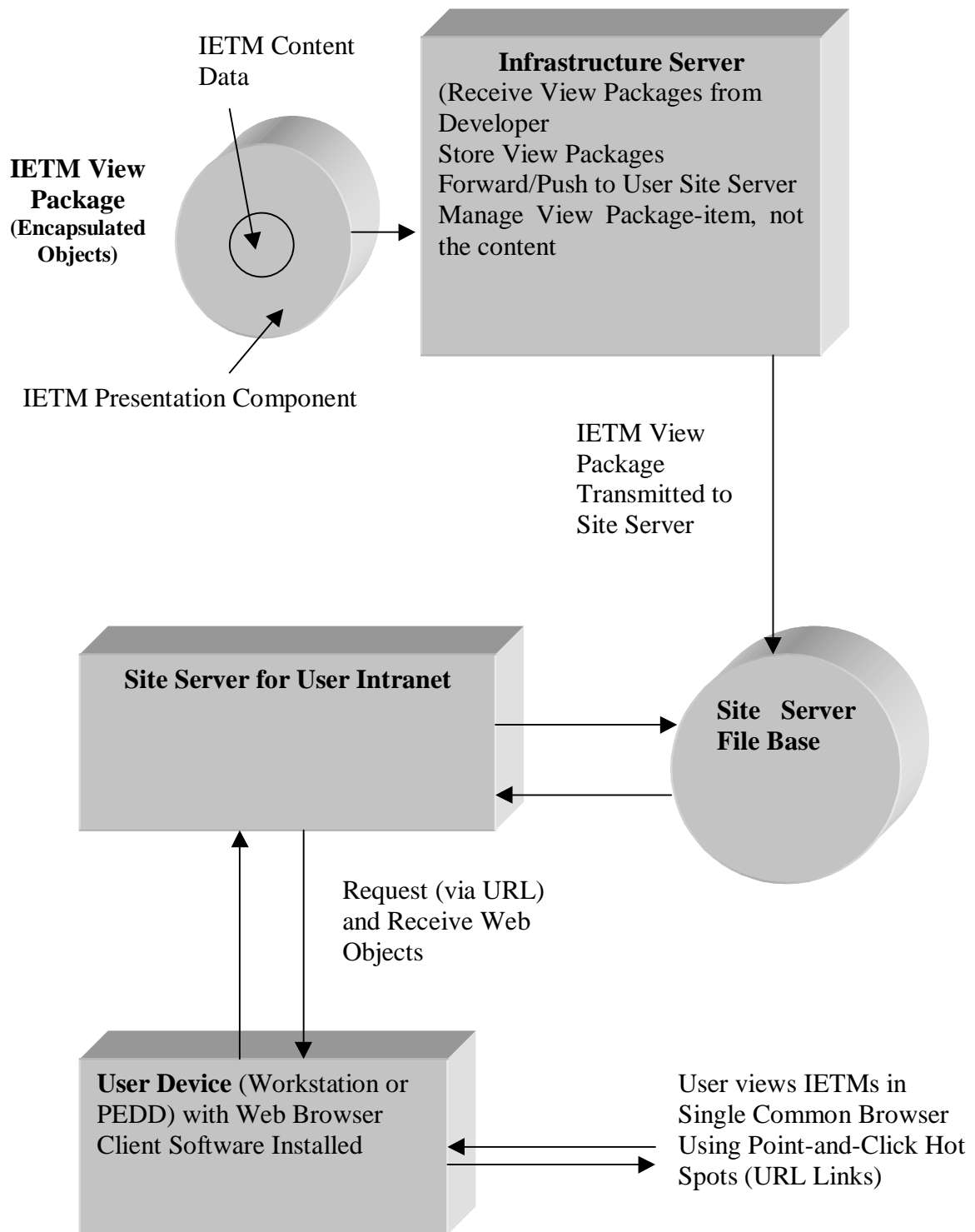


Figure 7-1. Flow of IETMs Through the JIA

7.10.2 Benefits for the IETM Developer

The principal emphasis of the JIA from the IETM-developer perspective is this. All software components and data (needed to make an IETM accessible on the JIA display device) are bundled into a single digital product (i.e., the encapsulated object), easily installed as a set of data files onto an intranet-server file system. The primary benefit to the IETM developer of that object-oriented concept is that you are free to choose whatever authoring and development environment is preferred. The JIA does not dictate how the IETM is to be developed nor what the internal format of the IETM object must be. External interfaces are in accordance with electronic-document authoring environments being adapted to operate on the World Wide Web and, as such, should operate equally well on a JIA-compliant intranet. Proofing tools for IETM objects are also easy to set up as a JIA-compliant intranet and JIA browsers are made up of available software products which the authoring activity can procure. Again, the design philosophy for the JIA is to use the best readily available commercial practices for developing and deploying IETM products.

While the technology needed to bundle all of the IETM components into a single digital package is complex, it is readily available in C/NDI products. These are inexpensive, relative to traditional IETM products, and easy to obtain. There has been an unprecedented rush by suppliers to get competitive products into the commercial market. A fundamental principal of the JIA is that the products developed for the Internet can be used to develop IETM products for a JIA-compliant intranet. This process is in contrast to current practice, where the IETM product is delivered as two separate items, the IETM content data and the IETM presentation system software program.

7.10.3 Benefits to the DoD IETM Distribution Infrastructure

The primary benefit of the JIA to the DoD IETM digital distribution infrastructure is that encapsulated IETM objects can be distributed without requiring that the distributing system know what is inside the electronic capsules. The infrastructure activities can therefore be simple distribution centers, for which the DoD has substantial experience, and not data-processing centers, which would be much more difficult to operate and staff.

The specific design of and development of a specific DoD component infrastructure is not within the scope of the JIA effort. This infrastructure design will undoubtedly be a complex task that will be further complicated by the impact it will have on many existing business practices. However, the JIA element which enables the objects to be processed as an item of supply (with no requirement to manage the internal content or structure of the object), should make this task more manageable.

7.11 Architecture Types

In practice, the implementation of an IETM intranet may be simpler (as is the case with basic HTML pages) or more complex (as is the case with most custom servers) than the baseline Operational Flow described in the previous section. The following breakdown of anticipated IETM view packages by architecture type is presented to categorize variants and to provide implementation guidance. Any particular IETM intranet implementation will typically contain a

mixture of these types. The four types of categories represent a continuous spectrum of variation (i.e., some applications will be difficult to categorize precisely). However, identifying the types will make it easier to present guidance in the JIA, particularly regarding the Server and Database Interface Specification. Definitions of these Architecture types are given in Table 7-1.

Type definitions are grouped into two categories:

1. The baseline architecture, IETM Architecture Types C1 and C2. Definition of these two client-centric Architecture types has essentially been completed. These types require only a browser and a generic HTTP server.
2. The extended architecture, Architecture Types S1 and S2. For these server-centric types, the technology for employing the additional servers in the Web environment is less mature and more diverse. This segment of the marketplace is emerging and it is still dominated by proprietary products. This situation is in large part due to the fact that vendors have opened the browser products to the public domain (a market where little money is to be made) and have kept the server market proprietary (where vendors see profit potential and seek competitive advantage).

7.12 Characteristics of Architecture Types

Architecture Types C1 and C2 share common important characteristics; they do not require installation or operation of unique software on the server. Thus, the server can be treated as an electronic bookshelf. As far as the server is concerned, the two parts of an encapsulated object (the data and the associated software components) are simply treated as files. Additionally, any contemporary HTTP server can be employed and it does not matter what operating system is utilized. Thus, for Type C1 and C2 IETM applications, interoperability is very low-risk in the sense that, any IETM view package can be accessed using any server. Only a generic server is required for Types C1 and C2 and no JIA-specific server specification is required. Both types are considered pure encapsulated-object types; however for Type C1, the component part of the object can be implied (i.e., omitted), as its presence can be assumed as preinstalled on any JIA-compliant browser and need not be included in the transported IETM view package.

The Type C1 definition is closely tied to the specific versions of HTML and XML, a factor which needs further clarification. For planning purposes, it is recommended that emerging standards (and not current standards) for both HTML and XML be used to define the JIA requirement. In this light, HTML/XML is herein specified as employing both HTML version 4.0 and XML version 1.0 (including the associated XSL style and XLL linking specifications), when these two International W3C (World Wide Web Consortium) standards are formally approved. HTML 4.0 is a mature specification and should soon be approved, while the XML family of standards is still a year or two away. There are several reasons for this recommendation. The future standards will almost certainly be relevant in the time frame when most applications are developed according to the proposed architecture, so the best estimate as to what will be applicable should be used. Vendor implementations of the draft standards are available now for test purposes.

Another important consideration is that there has been written commitment by many major software vendors to support future standards, whereas there is no complete agreement on the delivered-product support of the current standard (i.e., HTML 3.2). In particular, vendors have indicated support of the emerging HTML 4.0 standard. Additionally the XML standard has elicited widespread vendor promise of support as a user-extensible expansion of HTML. XML lags behind HTML 4.0 in maturity, but is sufficiently complete so that prototype software exists from major vendors, and shows promise of becoming a Web-based tagging standard that is more suited to complex IETMs than HTML. In particular, it will be much easier to convert the large DoD inventory of SGML-tagged source data to XML for a runtime object than it is to convert it to HTML for presentation.

For Type S1 and S2 IETM applications, the situation for ascertaining de facto industry practices is much more complex. Several approaches are available for standardizing many issues such as Microsoft's design-time controls, Active Server Pages (ASP), and Front Page server extensions, and a variety of third-party middle-ware products; but they are all proprietary and not universally accepted. The technology of C/NDI are not sufficiently mature at this time to propose any one of them as a DoD standard so that all IETMs can operate on a single server. There are two possible approaches for a working solution to operational interoperability with a particular server in the short term:

1. The various IETM providers must put their own physical server(s) plus the IETM view packages on the shared user intranet. This is very feasible with the state of the art and capacity of today's portable computers and plug-in network standards; or
2. Require that all IETM creators use the same sets of server components and that the standard components be installed on all intranets employed in the community throughout which the IETMs are interoperable. However, for multi-service operations, this alternative is not practical.

Table 7-1. Proposed IETM Architecture Types

Type	Characteristics	Examples
Type C1: Basic HTML/ XML Pages	HTML/ XML page(s) with only browser-resident components. Requires no component licensing. Most will work on any browser. Includes HTML 4.0 scripts. Client processing only. "Basic" HTTP server.	HTML with Java script, GIF, JPEG, frames XML + XSL Style Sheets
	Note: HTML/ XML pages may be used to include one or more Type C2 custom components. If the HTML/XML tags no displayed content, it is considered Type C2. If it does contain tagged data, it is a combination C1/C2.	C1/C2 examples: HTML file plus Java "bean(s)" HTML file plus plug-in HTML file plus ActiveX control(s)
Type C2: Simple Component	One data set plus one custom automatically downloaded non-HTML component.	.pdf plus Acrobat reader control .doc plus WordView control
	May be nested Type C2 data-set/component pairs ("encapsulated objects"). First component loaded into browser shell/container has capability to access another client component and associated data set under control of original component. Requires component licensing. Not recommended for new applications. Client processing only. Uses "basic" HTTP server.	Legacy systems reprogrammed as custom browser or presentation system operating inside a standard browser shell/container.
Type S1: HTML Plus Application Server	Two-tier architecture in which Web page includes reference to server application(s), which must operate before page is delivered to client as Type 2 HTML/ XML. Data and components managed on server. May utilize database collocated on server, but most content is in Web page files. Requires HTTP server with components for server-side computations. Requires client <i>and</i> server processing.	MS Front Page Webs MS Design-time Controls CGI Server Apps DynaWeb
Type S2: HTML with Database Server	Three-tier architecture that includes a Web page server with pages functioning like a template; e.g., for calls to a database, which contains most of the IETM content. Can include server and components for custom functions. Requires a database server (e.g., Oracle) in addition to the HTTP server. Can use MIL-PRF-87269 Data model for database on server. Permits both Client <i>and</i> Server processing.	AIMSS 4.0 (planned) GD TechSight Web MS ASP w/ODBC Calls

7.13 Elements Diagrams for Architecture Types

The core Architecture (Types C1 and C2) requires two kinds of software elements: client browsers and Web servers, as illustrated in Figure 7-2. In general these are hosted on separate

devices connected by a TCP/IP network. However, an intranet can also be set up in a single display device without a network. In the case of IETM Architecture Types C1 and C2, these two kinds of elements are all that is needed. In the case of Type S1 (Figure 7-3), a requirement exists for an additional element, the application server, sometimes referred to as a Web server extension, since it effectively operates in the same operating system as, and is an extension of, the HTTP server. In the case of Architecture Type S2 (Figure 7-4), there is the additional requirement for a database server which hosts most of the IETM content, which may or may not be hosted in the same device as the Web server. A Type S2 application usually includes aspects of a Type S1, since it requires an application server to process the data access and request dialog between the Web server and the separate database server. Note that while the line between these two types may not be clear, in general they differ in where the primary data content is stored (i.e., in the server files or database server).

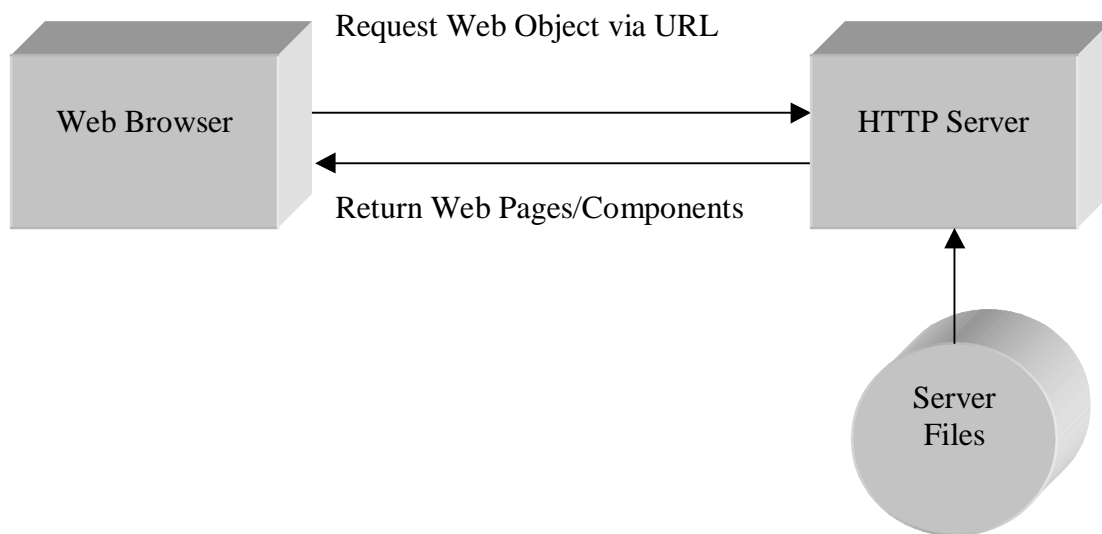


Figure 7-2. Elements for Architecture Types C1 and C2

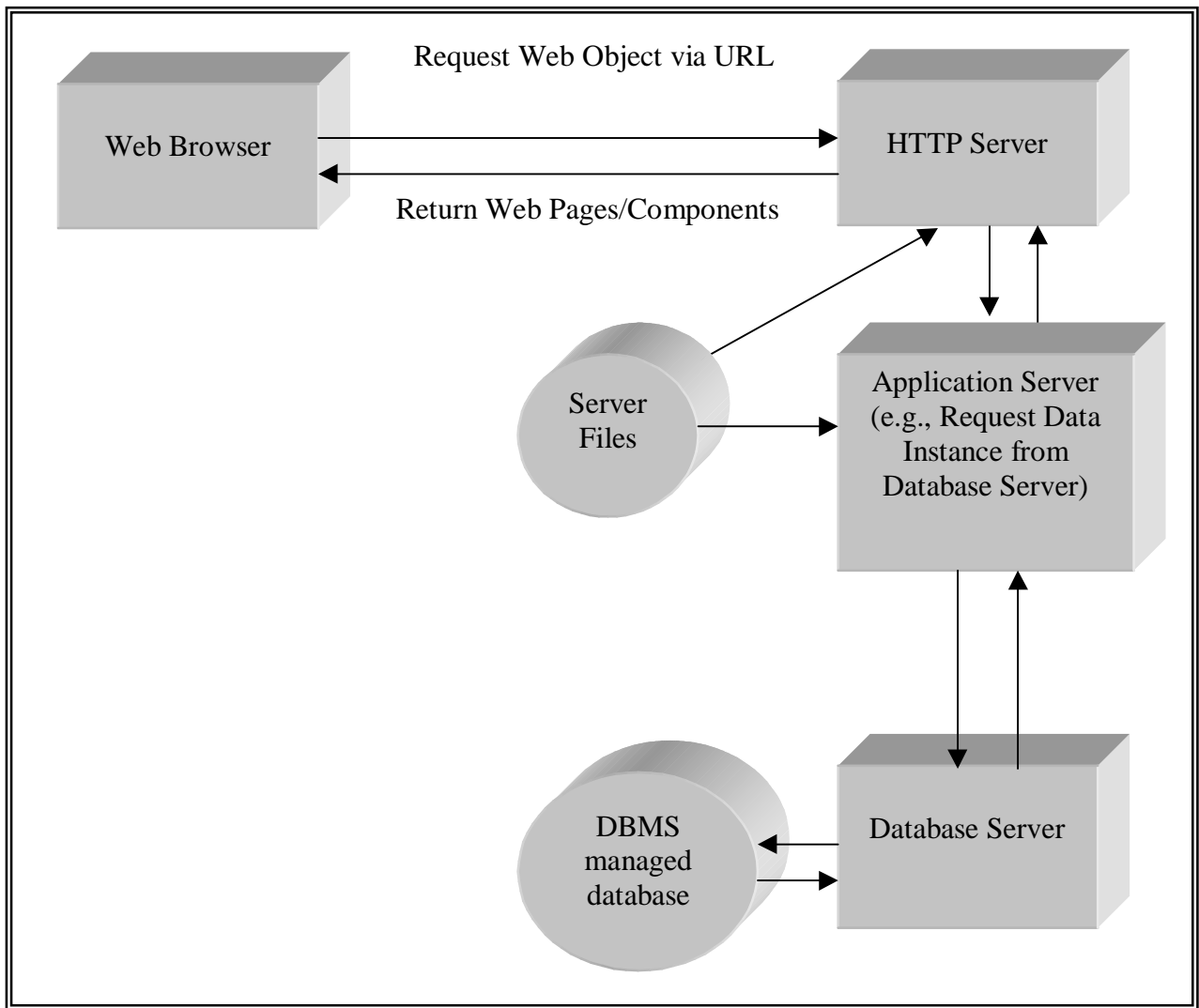


Figure 7-3. Elements for Architecture Type S1

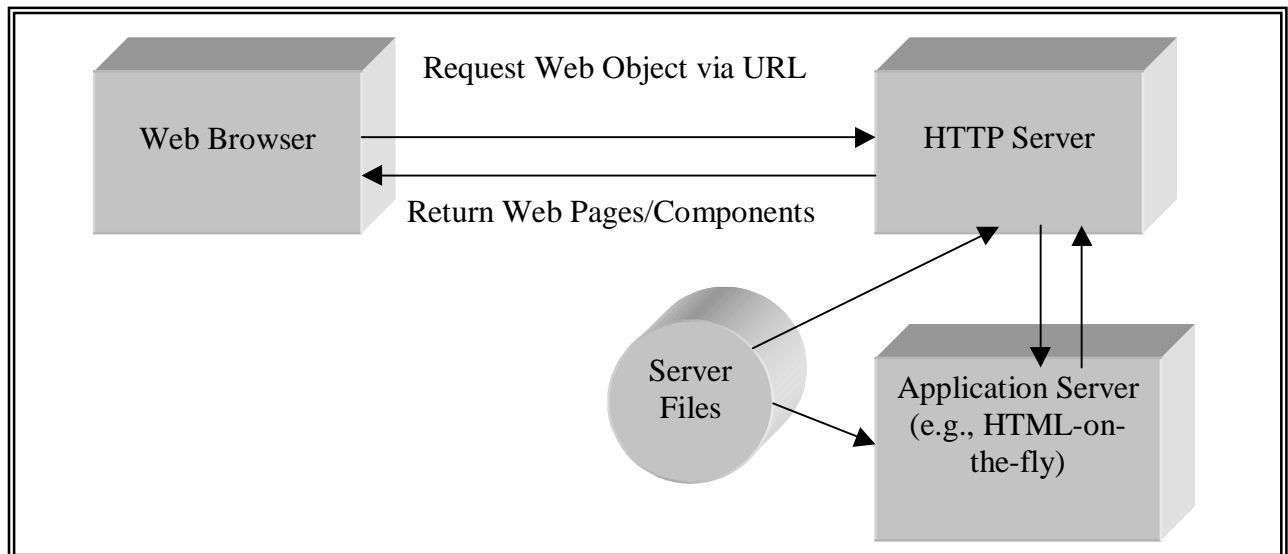


Figure 7-4. Elements for Architecture Type S2

7.14 Pilot Programs

Each of the services selected pilot programs to test the JIA goals and objectives (Table 7-2) The selection encompassed each of the architecture types previously described. During the October 1998 CALS '98 Expo in Long Beach, CA, the conceptual JIA was successfully demonstrated. The pilot programs were hyperlinked to demonstrate that regardless of architecture type, authoring system or service, the IETMs could be viewed using a Web browser.

Table 7-2. JIA Pilot Programs

Service	Program	Technology Demonstration	Architecture Type
NAVY	LM-2500	SGML to HTML	Type C1
	LINK-16	SGML to HTML	Type C1/C2
	F-18	Quill to Web-based	Type S2
	ATIS-AIR	PDF to Web-based	Type C2
	NSSN Library	SGML to HTML/XML	Type C1
USMC	Diode Test Set	PDF to Web-based	Type C2
	TAOM	MediaLynk to Web-based	Type S1
	AAAV	TechSight to Web-based	Type S2
	Sweep Function Generator	PDF to Web-based	Type C2
AIR FORCE	MPTO	PDF to Web-based	Type C2
	F-22	Paper study	N/A
ARMY	PPS-5	PDF to Web-based	Type C2
	EPLRS	SGML to Web-based	Type S1